

Summary of Fuel Cell Programs at the NASA Glenn Research Center

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Regenerative Fuel Cell System Technology

The objective of this program is to develop passive ancillary component technology to be teamed with a hydrogen-oxygen unitized regenerative fuel cell (URFC) stack to form a revolutionary new regenerative fuel cell energy (RFC) storage system for aerospace applications. Replacement of active RFC ancillary components with passive components minimizes parasitic power losses and allows the RFC to operate as a H_2/O_2 battery. The goal of this program is to demonstrate an integrated passive 1kW URFC system.

Zero Emissions Aircraft

The Zero CO_2 Emissions Technologies Project is focused on the elimination of CO_2 emissions from civil transport aircraft by conversion of their propulsion systems to hydrogen fuel and by the introduction of new energy conversions technologies, i.e. air-breathing fuel cells, to produce an environmentally benign, low cost and durable system. NASA GRC is involved in the system level design and analysis of the fuel cell systems. These systems range in power from 100 kW for a General Aviation aircraft to 90 MW for a Boeing 777 aircraft.

Revolutionary Aeropropulsion Concepts

Next Generation Fuel Cell, funded under the Revolutionary Aeropropulsion Concepts Project, is intended to develop and demonstrate revolutionary energy conversion technologies to achieve reduced emissions aircraft operations. The focus of this program is on far-term, breakthrough technologies. The overall approach is a multidisciplinary effort to develop a revolutionary, non-traditional fuel cell power/propulsion system for aircraft applications. Areas under investigation include; cell chemistries, advanced materials, and novel cell, stack, component and system designs. As in the Zero CO_2 program, the systems will range in power from 100 kW to 90 MW.

PEM Fuel Cell Technology for Reusable Launch Vehicles

Proton Exchange Membrane fuel cell (PEMFC) technology offers major advantages over existing alkaline fuel cell (AFC) technology for space vehicle applications, including enhanced safety, longer life, lower weight, improved reliability and maintainability, higher peak-to-nominal power capability, compatibility with propulsion-grade reactants,

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and the potential for significantly lower costs. A team comprised of NASA Glenn, NASA Marshall Space Flight Center, and Honeywell (formerly AlliedSignal Aerospace) is involved in the development of modular proton exchange membrane fuel cell stack technology for use in future reusable launch vehicles under a NASA Research Announcement. The overall goal of the PEMFC program is to develop compact, high fuel efficiency, high thermal efficiency, reliable PEMFC stacks that will serve as the basis for an affordable, short-duration PEMFC power plant flight development program. Under this NRA, small substacks as well as a prototype 5.25 kW modular PEMFC stack have been successfully built and operated.

Proton Exchange Membrane Fuel Cell (PEMFC) Powerplant Development for 2nd Generation Reusable Launch Vehicle

NASA Glenn, NASA Johnson Space Center, NASA Kennedy Space Center, and NASA Marshall Space Flight Center have proposed a 5-year PEMFC powerplant development program that will advance PEMFC technology from a Technology Readiness Level (TRL) of 4 to a TRL of 6. NASA will be responsible for defining requirements, developing system specifications, and testing the contractor hardware. A modular approach will allow NASA to leverage the evolving and highly competitive commercial market in PEMFC technology, assuring technology transfer and low costs well into the future.

Environmental Research and Sensor Technology (ERAST)

The Environmental Research Aircraft and Sensor Technology (ERAST) project is aimed at the development of aeronautical technologies that are expected to produce a new generation of remotely piloted or autonomous aircraft for a variety of long duration upper-atmospheric science missions at altitudes of 60,000 to 100,000 ft. These aircraft will eventually be powered by solar cells and will contain a regenerative fuel cell system to provide power during the night. The ERAST program is currently developing a 5.25 kW regenerative fuel cell system for the Helios prototype aircraft. In conjunction with our ERAST partner, NASA Glenn provides: technical assistance to the fuel cell/electrolyzer developers during their development and testing of hardware for the Helios power system, systems analysis, design of the regenerative fuel cell system, testing of individual fuel cells and electrolyzers, and testing of the regenerative fuel cell system.